CHAPTER THREE

# PRODUCT DEVELOPMENT

## CONTENTS

# THE INDUSTRIAL BASE

## OBJECTIVE

This chapter of the guide establishes a model of the process by which products are developed and produced for use. A generic development process is described to serve as a basis: (1) for integrating the specific manufacturing management activities and issues discussed in the Guide, and (2) to obviate the need for major revision of the text which could result from changes in the DOD development process. This generic process is compared with the current DOD process (as it has been modified during the DOD Acquisition Improvement Program) to establish a correspondence between the DOD phasing and terminology and the Guide material.

## INTRODUCTION

A large variety of products (defense systems and equipment) are developed and produced for the DOD. The process by which these products are developed and produced contains basic similarities from one product to the next. The generic process (Figure 3-1), which we will explore here, is applicable to commercial as well as DOD products.

### Identification of Need/Opportunity

The process starts with the definition of the need for a product or the identification of an exploitable technological opportunity. Each of these possibilities needs to be examined separately. In the commercial arena, companies are continually evaluating their markets to determine market segments which are not being served with an appropriate product and which could be profitably served by a new product or a modification of an existing product. DOD, in a similar vein, continuously reviews the operational missions assigned to its forces to determine areas which are not adequately served by the available weapons. In the commercial as well as the military environment, needs which are identified are structured in terms of the “market place” — consumer needs or military operational performance. These functional descriptions thus serve as the basis for initiation of a product development.

In a similar vein, both DOD and the commercial business entities are continually performing or sponsoring research efforts. Often these efforts uncover technologies which, if exploited, could yield a significant advantage. In this case, the “market” is evaluated to determine in what form the technology should be developed in order to yield maximum advantage. This analysis also produces a functional description of the performance of the eventual product or weapon system and can serve to initiate the product development process.

### Candidate Concepts to Satisfy Need

After the need or opportunity has been defined, the second phase of the process involves search for and selection of candidate concepts to meet the need or apply the exploitable technology. This phase is somewhat unconstrained in the sense that limits of cost, technology and time may be ignored during the process of defining candidates. The basic thrust is to allow creativity and innovation to flourish, hopefully yielding optimal solutions to the defined problems. Within the commercial environment, the initial definition of the problem may be constrained in terms of the eventual cost to the consumer of the product to be developed. This constraint may result from the decision to exploit a particular selling price range within the competitive marketplace and, as such, the candidates must have a reasonable likelihood of being produced at a cost compatible with the defined selling price.

### Development of Budgets and Schedules

As the process of budget and schedule development begins, some of the constraints of the “real world” are applied to the candidate concepts. Within commercial entities, as well as the DOD, there are limited resources which may be applied to development and production of products. One constraint which impacts DOD, as well as the commercial entity, is the issue of affordability. The basic question is whether the capability of the product is sufficiently valuable such that the potential cost can be justified within the limited resources forecast to be available. In the commercial sector, this would involve estimating the ability of the product to compete effectively for the target consumer's budget. In the military environment, the focus is on the ability of the product to justify the necessary level of allocation of DOD budgetary resources. The budget development process causes the candidate concepts to compete among themselves for resources, as well as to compete with other development programs under consideration by the organization. The final apportionment of resources by the organization reflects such issues as the magnitude of the need or opportunity, the expected benefits to be derived from the development program, the level of resources required and the perceived likelihood of success. These initial budgets and schedules are normally firm for the early exploratory phases of the process but reflect estimates or targets for the later phases.

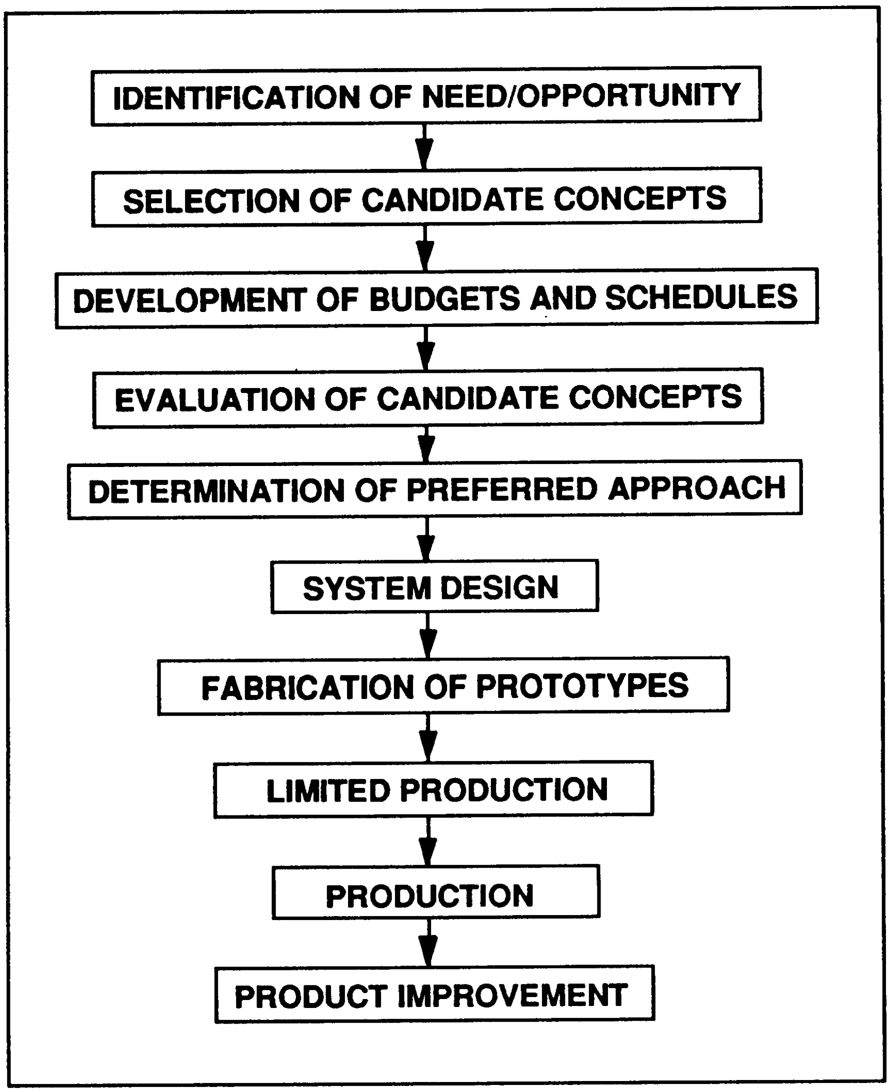


**Figure 3-1 The Generic Product Development Process**

Evaluation of Candidate Concepts

During the portion of the process involving the evaluation of candidate concepts, decisions are made which have profound impact on the nature of the product or system which results from the development process. These decisions are embedded in the set of criteria which are used for evaluation of the candidate concepts. The inclusion of a measure such as cost to produce at this early phase can weight the development cycle toward products whose costs are within, or at least near, the “affordable” zone. Conversely, excluding or minimizing such a measure would tend to allow for development of a product or system whose cost may later prove to be prohibitive. This argument applies equally well to such other measures as performance, supportability or reliability.

The evaluation of candidate concepts can include actual fabrication of prototype hardware or physical models. It may also be limited to paper analyses or fabrication of portions of the eventual product or system. The critical issue to be addressed during this time period is the assurance that the technology embedded in the product is sufficiently well understood so that the product performance objectives can be attained within acceptable risk limits. The issue of the degree of acceptable risk is unique to the organization and may vary over time within individual organizations. It is necessary to develop estimates of the level to which each candidate solution will satisfy the established measures of effectiveness. These estimates can then serve as a basis for the decision to commit additional resources to one or more of the candidates which reflect preferred approaches.

Determination of Preferred Approach

The determination of the preferred approach utilizes the results of the evaluation of the candidates against the measures of effectiveness, in conjunction with the near term financial constraints, to define the nature of the next element of the development process. Unless one of the candidate solutions has been shown to be both technically far superior and attainable at low risk, it is beneficial to carry more than one candidate into a more explicit design. The decision maker needs to balance the higher probability of ultimate development success attendant to multiple alternatives with the cost involved with detailed design and test of the alternatives. The eventual choice normally reflects a compromise between these two factors.

System Design

When the preferred alternatives have been identified, detailed design of the extended product or system is initiated. The term “extended product design” includes design of the product in terms of its interaction with the manufacturing system from which it will be produced, the use environment it will face and other products or systems with which it must interface, as well as the details of the product itself. In the commercial arena, the emphasis on use environment has been strongly reinforced through increased product liability litigation and legal and regulatory actions such as recalls. In the military environment, there is increasing emphasis on assuring that systems can be effectively operated and maintained by the users of the equipment. The extended product design needs also to focus on the support of the product or system throughout its expected life. Repair concepts and maintenance service systems must be specifically defined for those products which are not consumables. The product or system itself must be completely defined so that prototype units can be constructed. Again during this effort there are competing cost pressures. The designers seek to attain the target performance capability within a defined budget. There is also emphasis on managing the design so as to control the cost to produce the product and the user’s cost to support it. These latter costs can be controlled but the control normally requires additional design iterations, thus increasing the cost of generating the design.

System survivability is the ability of a system to withstand or survive the external effects of a hostile environment and continue to perform the mission for which it is designed. Survivability considerations such as temperature extremes, shock, vibration, humidity, etc., are routinely considered during system design. However, the special areas of nuclear and nonnuclear survivability are not usually emphasized as much as the more conventional environmental factors mentioned above. These two special areas, particularly nuclear survivability, must be placed on equal footing during design with the other environmental factors for systems having these survivability requirements.

Fabrication of Prototypes

When the design is defined, prototypes are fabricated. There are two primary purposes for prototype fabrication. They are:

1. To demonstrate through test that the product has the features and capabilities required, and

2. To validate that the product can be built within the cost and time constraints.

When we look at the first of these objectives, it is important to note that many of the required attributes may be usage oriented, that is they speak to the utility of the product in its end use environment. The degree to which the product satisfies these required attributes (such as availability and reliability) will reflect the attention given to these attributes during the design phase and the degree to which realistic testing of these attributes in the prototypes can be accomplished.

The second objective for prototype fabrication can be achieved by actually building the prototypes in the manufacturing shops and recording the time and cost required. This approach is not available for most cases. Often, the design is not sufficiently stable to support the development of specific manufacturing instructions. It is also possible that the investment in production tooling is not justified until it is determined that the product should go into quantity production. As a result of these or other compelling reasons, the fabrication is often done by selected personnel, in special fabrication areas in accordance with media different from those used for quantity production. Thus, the validation of a manufacturing approach is often a projection of controlled experience into the actual shop environment.

The physical and functional testing of the prototype provides the basis for an informed decision to start quantity production. By testing the product against the defined performance objectives, a profile of the utility and value of the product is developed. Often the testing addresses two separate, but related issues:

1. How well does the product meet its defined performance objectives?

2. How well does it satisfy the current need of the ultimate user?

If both of these questions are satisfactorily answered and the product can be produced within the defined time and cost constraints, the product is released for quantity production.

### Production

The release for production normally involves a significant financial commitment for the developer. The manufacturing system must be adapted to the new product and often a significant amount of production tooling must be built and put in place. These efforts are often hindered by a need to incorporate some level of change to the design reflecting either shortcomings identified in test or recognized opportunities for improvement. Limited production involves establishing a base line design, a plan for change introduction and the organization of the manufacturing resources required to execute the design. The primary resources which must be acquired and applied are personnel, capital and capital equipment, technology and materials. One of the critical challenges in this phase is the control of the manufacturing process. It is of paramount importance to ensure that: (a) the design capabilities are not degraded in the as-built product, and (b) the cost to execute the design remains within target.

### Product Improvement

As production of the system continues and feedback is received from the users, there is often a series of product improvements which are defined and executed. When the product is competitive with similar products, these improvements are often driven by the action of competitors. The challenge in this phase of the cycle is to integrate these changes into the production system with minimum disruption and cost. The changes introduced reflect both improvements in the ability of the product to meet the original design objective and extensions of capability to meet increased or broadened performance objectives.

## MANUFACTURING MANAGEMENT FOR MAJOR DOD ACQUISITION PROGRAMS

### Introduction

The model of manufacturing management in system acquisition describes the major manufacturing tasks (activities) which are typical for major hardware development and production programs within the Department of

Defense. The tasks are described within the context of the acquisition process described in DOD Directive 5000.1, Major System Acquisition. The chart, included as Figure 3-2, lists the manufacturing tasks which are to be accomplished, as a minimum, in each phase of the acquisition process. Each of the tasks listed on the chart is described in overview fashion in the supporting text. The text also provides references to the Defense Manufacturing Management Guide for Program Managers where additional discussion of these topics may be found.

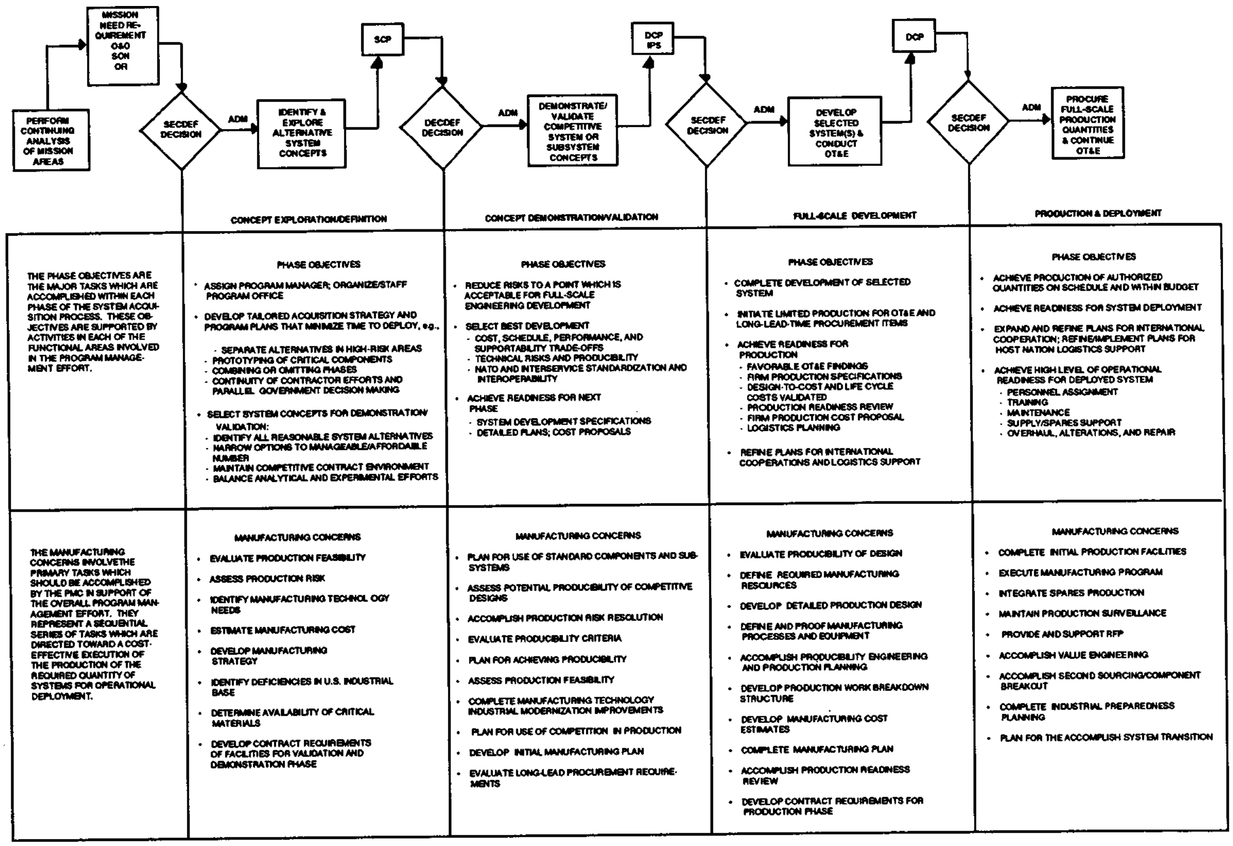


**Figure 3-2 Manufacturing Management For Major DoD Acquisition Programs**

The intent of the model is to provide an introductory overview of the manufacturing management tasks which should be accomplished to ensure a successful acquisition program. The development of the manufacturing system necessary to build the defense system is a complex task which may rival the complexity of the defense system design process. If it is to be successfully accomplished, proper action is required from the earliest phases of the acquisition process.

The manufacturing activities described within this model reflect those actions typical of a major DOD hardware acquisition program. Where the primary emphasis of the acquisition is on software, firmware or subsystems, there may be substantial difference between the model and the actual activity. For these types of acquisitions the model may be viewed as a general guide to the kinds of activities which should be considered. These considerations must be tempered with the realities of the acquisition program and the differing end objectives of the program. There may also be differences where the objective of the development process is an electronic system. This type of system, while requiring similar types of activities as mechanical systems, often involves earlier fabrication of the models and prototypes which can be subjected to test. In this event, the other supporting activities described in the model may occur at earlier points than are described in the model.

The manufacturing management effort is a subset of the total program management planning and execution. Consequently, the plan for accomplishment of the manufacturing activities should be embedded in the program management planning documents early in the development cycle. In developing the manufacturing management approach, it is critical to note that the activities for all phases should be defined relatively early. This early definition is necessary since activities appropriate for later phases often need to appear as statements of intent or planning guidance in the program documentation or contracts developed in earlier phases. It is therefore suggested that the total model be reviewed when developing plans or contractual requirements for a specific phase. This will allow the manufacturing manager to consider the potential impact of future activities and establish a base line for the types of activities which should have been accomplished in earlier phases. Where these preceding events have not occurred, the manufacturing manager can determine if the activities described for the phase of interest need to be modified to account for accomplishments to date.

The model is developed from the perspective of the DOD manufacturing manager. It focuses on the responsibilities of the personnel involved within the program management office for achieving a capability to successfully enter and complete the production phase. While many of the activities described in the model reflect actions to be taken by the prime and subcontractors, the model is not meant to be a total description of the contract responsibilities. Since many of the actions required to achieve the manufacturing management objectives are accomplished through contract actions, the last section of this model provides a brief discussion of the support required from manufacturing management personnel during the solicitation and award process.

## MANUFACTURING CONCERNS DURING THE CONCEPT EXPLORATION/DEFINITION PHASE

### Evaluate Production Feasibility

The program manager should ensure that a manufacturing feasibility assessment is accomplished in the initial phases of product development. The feasibility estimate determines the likelihood that a system design concept can be produced using existing manufacturing technology while simultaneously meeting quality, production rate and cost requirements.

The feasibility analysis involves the evaluation of:

1. Producibility of the potential design concepts.

2. Critical manufacturing processes and special tooling development which will be required.

3. Test and demonstration required for new materials.

4. Alternate design approaches within the individual concepts.

5. Anticipated manufacturing risks and potential cost and schedule impacts.

The feasibility assessment is accomplished to bound the manufacturing risks incurred in selecting a particular design, fabrication concept and material as the basis for moving into the concept demonstration and validation phase. Without this type of assessment, the program manager may find that later phases of the program cannot be accomplished within the defined thresholds as a result of incompatibilities between the system design and the manufacturing technology available to execute it.

Guide References: 6-1, 8-1

### Assess Production Risks

Based upon the feasibility assessment, the program management office should develop a manufacturing risk evaluation to quantify the statement of manufacturing feasibility. Manufacturing risk assessment is a supporting tool for the contractor and program office decision making process. It seeks to estimate the probabilities of success or failure associated with the manufacturing alternatives available. These risk assessments may reflect alternative manufacturing approaches to a given design or may be part of the evaluation of design alternatives, each of which has an associated manufacturing approach. It should also consider the sensitivity of the feasibility estimates to the assumptions which were made on those areas of the design for which specific design data were not available.

The quantified risk levels can then serve as the basis for the development of specific risk resolution approaches for the later phases of the acquisition cycle and can provide guidance to the budget estimation process. In programs where manufacturing risk has not been addressed during development phases, there have been problems during the production phase involving high cost, extensive design changes, unplanned material and process changes and difficulties in delivering hardware which conforms to the contract requirements on time.

Guide References: 6-3

Identify Manufacturing Technology Needs

The evaluation of manufacturing capability is based on the analysis of the compatibility of the demands of the manufacturing task and the manufacturing facility and equipment required to accomplish it. Part of the result of the manufacturing feasibility evaluation is the identification of manufacturing technology needs. The needs are identified so that the kinds of manufacturing capabilities that will be required can be put on line in the factory prior to the production phase. When manufacturing technology development programs involve some risk, the program manager should consider requiring the design contractor to identify (or develop) fall-back positions for each of the risk areas and/or demonstrate the required capability in the laboratory or in pilot production.

Guide References: 4-3, 8-5

Estimate Manufacturing Cost

At the level of system definition typically available during the concept exploration phase, detailed manufacturing cost estimates cannot be developed. There is a need, however, to develop estimates of the level of resource expenditures that will be required to develop and produce the various system alternatives. These estimates will be used as part of the evaluation of affordability and in establishing initial program thresholds. In most cases, the estimates will be developed through the use of statistically based cost estimating relationships (CERs) or by comparison of the proposed systems with similar systems whose costs are known. The cost estimates will be used for evaluating and selecting system concepts for entry into the concept demonstration and validation phase.

Guide References: 9-5

Develop Manufacturing Strategy

Program production strategy is a subset of the overall acquisition strategy. Specific decisions need to be made concerning the level of competition which is to be attained during the production phase. If the program will be dual sourced, the early planning must take into account the strategy required to assure availability of capability and data and data rights for dual sourcing. New manufacturing technologies, if required by the system concept, will require specific plans for development, proof and transition of the technology to the eventual producer. This effort will necessitate close coordination with the Service manufacturing technology organization to assure compatibility of the technology development schedule with the system development schedule. Many studies have shown that competition makes a major contribution to reducing weapon system cost. If competition is to be effective, it must result from the application of a clearly defined strategy to ensure that an environment of true competition can be established and maintained.

Guide References: Chapter 4

Identify Deficiencies in U.S. Industrial Base

The manufacture of the system concepts under evaluation will require a particular mix of type and quantity of manufacturing capabilities. The various system concepts need to be evaluated to define the demand that they will create for specific materials and manufacturing processes. These demands need to be compared with the current and forecast ability of the defense industrial base to insure that the required capabilities will be available. Where deficiencies are identified, the management strategy should be modified to adapt the system design to the forecast capability, or action should be initiated to motivate industry to create the capability required. If neither of these actions is feasible, the development or adaptation of government-owned facilities may have to be pursued.

This identification must also consider the capabilities of the subcontractors. Chapter 2 provides information indicating that there is a deteriorating capability of the subcontractor base to support the planned levels of production from both a quality and quantity standpoint.

Guide References: 2-2

Determine Availability of Critical Materials

A number of materials are classified as strategic by the U.S. Government for industrial and defense purposes. For many of these materials the United States is heavily dependent upon imports. Defense system performance may be dependent upon the use of one or more of these materials. In some cases the future availability of these materials is dependent upon factors beyond the control of the program manager or the U.S. Government. In the evaluation of the alternate system concepts, needs for these critical materials should be identified and system acquisition planning should specifically consider the risk of their nonavailability. This may include measures such as the use of alternate materials (which may offer lower performance but have reasonably assured availability) or specific forward planning to obtain the required materials. This forward planning may include establishing a track of the availability and market for the required materials. If difficulties are forecast in obtaining the materials from the open market, it may be possible to place an advance buy or to obtain them from government stockpiles.

Guide References: 2-9

Develop Contract Requirements for Concept Demonstration and Validation Phase

The program effort during the concept demonstration and validation phase will be dictated by the specific requirements which are established and included in the contract(s). Manufacturing involvement during the demonstration and validation phase is primarily directed toward the resolution of the identified manufacturing risks, the assessment of system producibility and the development of initial production plans. Specific statement of work language and data item requirements need to be established to clearly identify the specific tasks which the contractor is to accomplish. Broad general statements which establish objectives for the manufacturing management function in the early phases of the program will not normally result in cost-effective, producible designs.

Guide References: 3-21, Chapter 10

## MANUFACTURING CONCERNS DURING THE CONCEPT DEMONSTRATION/ VALIDATION PHASE

Resolve Production Risk

Production risk resolution involves demonstrating the attainability of the levels of manufacturing capability required. During this phase, it is not necessary that all the details of the production processes be demonstrated. The areas that represent advances beyond the current capability should be demonstrated in environments which are somewhat representative of the production floor. The focus is on determining that there is a reasonable expectation that the manufacturing materials and processes which will be required can be obtained or fabricated in sufficient quantity and quality to meet the production phase requirements. Deferring risk resolution to a later phase incurs a concern that the design will have to go into production relying on the processes or materials which have relatively unpredictable processing time and cost. There is the possibility that compromising efforts to meet quality, cost, and schedule goals may adversely affect technical performance of the end item.

Guide References: 4-5, 6-3

Complete Manufacturing Technology Developments

For those technologies identified during the concept exploration phase as requiring development, laboratory demonstrations should be accomplished. As with the system development program, the manufacturing technology development often represents a phased approach to definition and demonstration. The technology developer should demonstrate that the required process or material capability is attainable under laboratory or controlled conditions and also describe the procedure by which the technology can be extended into the manufacturing shop environment. Since it is normally anticipated that critical processes will be demonstrated in the production environment during the full-scale development (FSD) phase, it is important that the laboratory (or controlled production) process capability be demonstrated during this phase. Failure to do so may increase the risk, during FSD, that the material or process may be found not to be a viable approach for meeting the weapon system design requirements.

Guide References: 8-5

Develop Initial Manufacturing Plan

The purpose of the manufacturing plan is to portray a method of employing the facilities, tooling, and personnel resources of the contractor and subcontractors. It should reflect all the time phased actions which are required to produce, test and deliver acceptable systems on schedule and at minimum cost. During the Concept Demonstration and Validation (DEMVAL) Phase the prime contractor(s) should be tasked to prepare an initial draft of the manufacturing plan. This plan should reflect the degree of system definition attained during concept DEMVAL, identify the fabrication methods planned within the facilities, and estimate personnel resources forecast to be available during the production phase. The plan will also reflect the programmatic decisions concerning the degree and type of competition in the production phase and the needs for long lead procurement or limited production. Where it is anticipated that significant facilities modification or construction will be required, this effort should be described within the manufacturing plan. An initial description of the time phased schedule for both the Full-Scale Development and the Production and Deployment Phase tasks necessary to successfully produce the required quantity of systems should also be described. If it is determined that the learning curve will be applicable for scheduling and cost estimation, the elected slope(s) and base points (first unit, standard) should be estimated. The program office should carefully evaluate this schedule for reasonableness and attainability within the scope of the planned yearly program budgets.

Guide References: 6-2, 6-4

Assess Potential Producibility of Competitive Designs

Producibility is a measure of the relative ease of producing a product or system. It is also an engineering function directed toward generating a design which is compatible with the manufacturing capability of the defense industrial base. Each competing design needs to be evaluated from a producibility standpoint. The producibility effort must take into account the quantity of units or systems to be produced and the rate at which they will be manufactured, since quantity and rate determine the magnitude of the potential manufacturing efficiencies to be gained or problems to be avoided. Producibility evaluations will serve as a basis for estimating the likely manufacturing cost and assessing the level of manufacturing risk of the system. Results of these assessments will support the development of specific contractual provisions for the full-scale development phase. Specific requirements may be identified based upon the inherent level of producibility, the specific system designs, and the susceptibility of each to manufacturing cost reduction through an aggressive producibility program.

In assessing producibility of the various design concepts, it is important to define the types of production technology required and to contrast it quantitatively and qualitatively with the existing and forecast capability of the defense industry. There is a direct correlation between producibility and cost, which needs to be a part of the comparative analysis of the competing system designs. Ignoring the issue of producibility can lock the acquisition program into design solutions which can only be accomplished at unnecessarily high levels of production cost or design changes which can entail substantial technical, cost and schedule risk.

Guide References: 2-2, 6-2, 7-3

Evaluate Producibility Criteria

A part of the contract for the Concept DEM/VAL phase should require that the contractor develop producibility criteria to guide the design effort. The criteria should reflect a blending of general criteria (such as minimum parts count) and specific criteria applicable to the type of equipment being developed. The effectiveness of the producibility program will be controlled by the extent to which the design engineers understand and apply these criteria. Success also depends heavily on the definition of a clear complete criteria list and its communication to the design function.

Guide References: 7-10

Plan for Achieving Producibility

Achieving producible designs requires creating a plan that will permit the integration of producibility analysis into the mainstream design effort. As a result of the contract requirements, a plan should be created by the contractor which describes how these issues will be addressed within the organization which will create and test the design. Although many of the detailed tasks in achieving the producibility objective may not be accomplished until the Full-Scale Development Phase, the plan should describe specifically what activities will be accomplished in each phase, the responsible organization, and the management controls that will be established to ensure successful accomplishment. The PMO review should focus on the realism, completeness and clarity of the planning accomplished by the contractor. Formal submission of the plan may be required by the contract or the plan may be reviewed at the contractor facility.

Guide References: 7-10

Assess Production Feasibility

Production feasibility is the likelihood that a system design concept can be produced using existing production technology while simultaneously meeting quality, production rate and cost requirements. As a follow-on to the feasibility assessment accomplished during the concept exploration phase, the program office should use the increasingly more complete description of the system to update the assessment. This may be done within the program office or by the prime contractor(s). As the system design concept and manufacturing approach are validated and design decisions are made, the amount of flexibility on the choice of production technologies decreases. It is important for the program manager to ensure that design decisions reflect currently available production technology. Consideration of feasibility must occur in a bounded environment. The primary bounds are the existing state of production technology, the cost targets established for the system, and the production rate and schedule requirements.

Feasibility assessment is useful in supporting decisions concerning which of the competing system designs should be carried into FSD. It is also used to determine which of the manufacturing processes should be proofed during FSD and the nature of the proofing required. The process of weapon system design is dynamic and the search for the-best solution often involves changes to the design concept which can impact the manufacturing processes to be used. Failure to assess feasibility at a number of points during the acquisition process can result in accepting changes to the design which are incompatible with the capability of the industrial base.

Guide References: 5-4, 6-1, 8-1

Plan for Use of Competition in Production

If the program manufacturing strategy (see above) includes the use of competitors in the Production Phase, specific plans for achieving the defined level of competition must be established during the Concept Demonstration and Validation (DEMVAL) Phase. The Concept DEMVAL contracts establish whether there will be a competitive production phase and ensure that provisions are included so that the government receives the necessary technical data and rights to its use. During the Concept DEMVAL phase, the planning effort should focus on identifying the potential limits on competition which result from the various design solutions and on means for reducing their impact. Decisions should be made relative to the timing of the introduction of competition and the basis on which the competition will be held. If parts of the system are planned for later government breakout for competition, this should be clearly described in the contract to ensure that contractor plans are based on the same presumptions as the government plans. This can prevent later misunderstanding and friction during the execution of the production phase effort.

Guide References: 4-1, 4-8

Evaluate Long Lead Procurement Requirements

For many defense systems the time span between release of production funds and the required first delivery is less than the required lead times for some of the materials or subsystems. In developing the full-scale development (FSD) phase plans and the data for the Decision Coordinating Paper/Integrated Program Summary, the requirements for long lead materials or subsystems, both contractor and government furnished, should be identified. The funds required for these long lead items should be identified during the budget process. Determining the specific requirements for long lead funding is made difficult by the volatile nature of lead times for many defense materials. Where possible the analysis should be based on expected availability and lead times which are forecast to be in existence at the time of production start.

Guide References: 6-15, 11-11

Determine Need for Limited Production

Low rate initial production is a term describing a low rate of output at the beginning of the manufacturing program to reduce the government's exposure to large retrofit programs and resulting costs while still providing adequate numbers of hard tooled production items for final development and operational test prior to a full production decision. This approach can be used to minimize the risk of committing the necessary resources for the production phase by allowing for test and tryout of the manufacturing equipment prior to full production release. It also may provide test items which are fully representative of the production configuration. The difficulty in using a limited production approach is the need to invest in manufacturing tooling and test equipment earlier in the acquisition cycle. This may cause budgetary problems. There is also a risk that development and operational test results may indicate a need for design changes that will obsolete the tooling and test equipment.

Guide References: 4-5, 6-7, 11-12

Develop Initial Manufacturing Cost Estimate

One of the major elements of the life cycle cost of any defense system is the investment cost to produce the quantity required for deployment. The improved definition of system design and manufacturing planning should provide a basis on which the manufacturing costs can be estimated with greater precision than was available for the estimate accomplished during the Concept Exploration phase. The earlier estimate, in most cases, is based heavily on statistical and parametric estimating approaches. As the design definition increases, the contractor and the PMO should be able to replace these statistical estimates with estimates based upon specific design characteristics and features and a knowledge of the manufacturing system in which they will be fabricated. At this point in the development cycle we should not expect to have the specific design definition needed to develop a detailed estimate based upon manufacturing labor standards; however, it should be possible to utilize a higher order estimating standard such as hours-per-circuit- board (by type) or cost of castings based upon number of castings and total weight. If a design-to-production unit cost requirement is included in the contract, the reasonableness and attainability of the contractor's apportionment of the unit production cost goal should be assessed to prevent the program from being based on unattainable goals which will later cause unavoidable cost growth.

Guide References: 9-5, 9-17

Develop Production Readiness Review Plan

One of the major PMO program office tasks during the FSD Phase is completion of the Production Readiness Review (PRR). It is critical that the specific requirements for contractor planning and support to the PRR be included in the FSD contract. There is also a need to ensure that the necessary government evaluation skills are available during FSD. These needs can only be met if the major readiness issues are identified during the DEMVAL phase and the methods for evaluating readiness are clearly defined. The readiness issues must cover both the defense system design and the production planning required. Since many of these issues are normally evaluated as part of the continuing process of design and program reviews, the planning for PRR should clearly describe how the outputs and analyses of these reviews can be applied to the PRR task.

Guide References: 6-1, 12-3

Develop Contract Requirements for Full Scale Development Phase

The FSD Phase will involve the definition of the full detailed design for the weapon system, the logistics support structure and the manufacturing system. Specific statement of work language needs to be developed to cover those manufacturing areas which have been determined to be necessary during FSD. Typical areas to be considered for inclusion are:

1. Manufacturing management systems

2. Work measurement

3. Production planning

4. Producibility engineering and planning (PEP)

5. Production readiness reviews (PRR)

6. Reporting systems

7. Manufacturing data (including production plan)

8. .Make or buy

9. Technical data

10. Long lead authorization

If valid requirements exist for contractor actions during FSD, they must be included in the contract. If it is necessary to include them later by contract modification, the cost will almost always be greater and the efforts will start later than the optimal start time. These optimal start times are developed by analysis of the required set-back times required to allow completion of the necessary activity prior to the need date dictated by the program schedule.

Guide References: 3-21, Chapter 10

## MANUFACTURING CONCERNS DURING THE FULL-SCALE DEVELOPMENT PHASE

Define and Proof Manufacturing Processes and Equipment

Among the critical elements to be defined during FSD phase are the manufacturing processes which will be utilized to build the defense system. The sequence of manufacturing processes begins with the receipt of the raw material, where special handling and storage may be required. Additional processes requirements may include such items as cleaning, heat treatment, clean room controls, controlled testing and special handling (i.e., personal grounding requirements for electronic components). Identification of all processes must be a part of the design documentation. Where the selected processes contribute manufacturing risk to the program, the processes should be proofed during FSD. The purpose of proofing is to ensure that the process can produce repeatably conforming hardware within the cost and time constraints of the production phase. It is important that the proofing be accomplished in an environment that simulates actual production conditions. These conditions include the physical facilities, personnel and manufacturing documentation. It may also be necessary for the contractor to establish training and certification programs for the shop personnel to ensure that the process capabilities can be attained on a recurring basis.

Guide References: 4-5, 8-5, 8-12

Complete Manufacturing Plan

At the end of the FSD, all of the information necessary to plan the detailed manufacturing operations for the system should be available. This information should be described in a manufacturing plan covering the issues of manufacturing organization, make or buy planning, subcontract management, resources and manufacturing capability, and the detailed fabrication and assembly planning. The plan should also describe the types of Government Furnished Property (GFP) required and the specific need dates for it. The contractor management control systems, including those for configuration management, the control of subcontractors and manufacturing performance evaluation should be described in sufficient detail for the program management office to determine their expected utility. The plan developed should also include consideration of the potential requirements for industrial preparedness planning, including surge capability during the production phase and the post production phase requirements for support to employment of the system in combat situations. The development of this formal manufacturing plan contributes value to the program from two standpoints. The primary benefit accrues from the fact that the contractor has to crystallize the manufacturing planning to a point where it can be described in the detail required. The secondary benefit is the usability the plan provides to the program management office personnel. It serves as a basis for a structured review of the contractor approach, the expected cost of the production phase effort, and a fuller assessment of manufacturing risk. Where such a plan is not developed during the FSD Phase there is often unnecessarily high cost and schedule turbulence at the front end of the production phase.

Guide References: 4-1, 6-4, 6-20

Execute Producibility Engineering and Production Planning

Producibility, as noted above, is a measure of the relative ease of producing a product or system. Alternate manufacturing methods, materials, resources, and processes must be a consideration of the detailed design if the economics of manufacturing and assembly are to be considered. Producibility studies and analysis of the alternatives are conducted by the contractor with consideration of the impact on cost, schedule and technical performance. Early production planning based on design and schedule requirements is essential if production delivery schedules are to be fulfilled. Production planning must include identification of potential problems with an assessment of the capability required to produce the item and industry's current capability to manufacture the system as designed. Potential production problems that require further resolution by study or development must be identified and action for resolution initiated. The producibility engineering and planning effort also results in the definition and design of the special tooling and test equipment required to execute the production phase effort, as well as the preparation and release of the manufacturing data required for the start of manufacture.

Guide References: 4-3, 7-6, 11-10

Evaluate Producibility of Design

There are a number of factors to be considered in ensuring the producibility of a design:

1. Liberal tolerances (dimensions, mechanical, electrical).

2. Use of materials that provide optimum machinability, formability and weldability.

3. Shapes and forms designed for castings, stampings, extrusions, etc., that provide maximum economy.

4. Inspection and test requirements that are the minimum needed to assure desired quality and maximum usage of available and standard inspection equipment.

5. Assembly by efficient, economical methods and procedures.

6. Minimized requirements for complex or expensive manufacturing tooling or special skills.

There should be evidence that the contractor has accomplished producibility analyses of various options for the manufacturing task. The FSD phase results in the system design for entering production. As the design evolves during FSD, its producibility should be subjected to regular review (probably as part of the normal design review process.)

Guide References: 7-3, 7-10

Define Required Manufacturing Resources

One of the most important elements of any production design is the definition of the manufacturing processes. No matter how good a design may be, it is useless if system or product cannot be built. Although impossibility of production is unusual, the capability to produce the design may be limited or the costs to produce it may be excessive. It is therefore essential that availability of manufacturing resources be a consideration during the design review process. Manufacturing engineers should be a part of each design team to assure adequate consideration of availability of required manufacturing resources.

Manufacturing resources should not be limited to manufacturing methods but should include materials, capital, manufacturing technology, facilities, qualified labor, and the management structure to effectively integrate them. The successful completion of the production phase will depend upon the efficient application of the full spectrum of these resources to the task of fabricating and delivering the defense system design.

Guide References: 6-20, 8-1

Develop Detailed Production Design

Prior to release of drawings to manufacturing the detailed design drawings, bills of material and, product and process specifications must be completed. Further, it is essential that design reviews be conducted to assure that the contractor is complying with the design requirements and meeting the cost/design goals. The final design definition is the result of the performance requirements, the outcomes of the testing accomplished, producibility studies and other design influences. The production phase effort requires that the design be specified to a very low level of detail so that the required processes and resources can be identified and obtained.

Guide References: 11-14

Develop Production Work Breakdown Structure

The planning, execution and control of the production phase activities require that the work be divided into manageable tasks that are compatible with the existing manufacturing and performance measurement systems. Often, the work breakdown structure (WBS) used during the development phases will not be appropriate for the production phase. Consequently, the contractor should, as a basis for production planning, identify the WBS which is to be used. While this WBS may differ from the FSD structure, the two should be such that production phase costs can be related to the development WBS. This is critical for those programs which have utilized a design-to-unit production cost management approach during development.

Guide References: 9-17, 13-13

Develop Manufacturing Cost Estimates

As the definition of the system design and the manufacturing approach are completed during the FSD phase, the information necessary for more precise estimates of production phase manufacturing cost becomes available. During the FSD phase, the initial manufacturing cost estimate should be updated on a regular basis to reflect the increasing degree of detail available. These estimates should be based upon application of detailed manufacturing standards to the operations to be performed and adjusted, as necessary, by realization factors and/or learning curves to develop the time phased manufacturing cost. If the contractor(s) does not have a system for development and application of labor standards, strong consideration should be given to including a contract requirement, such as MIL-STD-1567A, Work Measurement, in the FSD phase contract. If there is to be an

Industrial Modernization Incentives program accomplished, the manufacturing cost estimate should be structured to reflect the expected benefits of this program.

Guide References: 9-5, 9-7, 9-9

Accomplish Production Readiness Reviews

The objective of a PRR is to verify that the production design planning and associated preparations for a system have progressed to the point where a production commitment can be made without incurring unacceptable risks of breaching thresholds of schedule, performance, cost, or other established criteria (DODI 5000.38). PRRs should be conducted by the program manager, as a time-phased effort that will span FSD and encompass the developer/producer and major subsystem suppliers. The PRR examines the developer's design from the standpoint of completeness and producibility. It examines the producer's production planning documentation, existing and planned facilities, tooling and test equipment, manufacturing methods and controls, material and manpower resources, production engineering, quality control and assurance provisions, production management organization, and controls over major subcontractors. The result of the PRR supports the program manager's affirmative decision at the production decision point, that the system is ready for efficient and economical rate production.

Guide References: 11-6, 12-3

Develop Contract Requirements for Production Phase

Specific requirements must be identified for inclusion in the statement of work for the production phase. The particular requirements reflect the areas that have been determined to be of importance, given the acquisition strategy of the program. Typical areas to be considered for inclusion are:

1. Manufacturing management systems
2. Work measurement
3. Manufacturing data (including manufacturing plan updates)
4. Initial production facilities
5. Production and material control systems
6. Manufacturing reporting systems (especially line of balance)
7. Control of subcontractors and vendors
8. Make or Buy program
9. Government Furnished Property
10. System audit
11. Technical data
12. Competition

Production phase incentives may be included to motivate contractors to improve performance and control costs. The benefits attainable through use of multiyear contracting should also be explored.

Guide References: 3-21, 4-9, Chapter 10

## MANUFACTURING CONCERNS DURING THE PRODUCTION AND DEPLOYMENT PHASE

### Execute Manufacturing Program

The primary function of the production phase is to complete the manufacture of the defense system within the established time and cost constraints. Normally, the production rate is structured to start slowly and build to a defined steady state rate. Much of the same type of evaluation of contractor planning for initiation of the production phase (generally through the PRR) needs to be focused on the contractor planning to increase to the defined rate. The program manager also needs to focus attention on the levels of engineering change activity. An excessive number of engineering changes can disrupt the structure of the manufacturing planning and result in high manufacturing costs. Also, attention needs to be given to ensuring that acceptance criteria for the product or system are clearly specified and that there is minimum use of waivers, deviations and Material Review Board actions during the acceptance process. The program office manufacturing personnel should participate in the Physical Configuration Audit (PCA) when the "as built" item is compared with the technical documentation. Upon satisfactory completion of the PCA, the primary acceptance criteria will be the physical and test requirements listed in the technical documentation. The completion of the production phase normally involves a series of contract actions which will need to be planned and completed to fill the system acquisition objective. For each of these contracts, a decision will need to be made on the contract type, the incentive structure, if any, the level of government control and the desired program visibility.

Guide References: 5-3, 10-1, 13-5

### Complete Initial Production Facilities

The Initial Production Facilities (IPF) include the special tooling, special test equipment and plant rearrangement cost necessary to accomplish cost-effective manufacturing. The design of the IPF should have been accomplished as part of the Producibility Engineering and Planning (PEP) accomplished during full-scale development. The PEP output includes a description and design of the required facilities and is based upon the production plan developed during FSD. Changes to that facility definition and design may be required if the production plan has been obsoleted by program changes or test problems. The timing of the IPF may pace the initiation of the production units if the manufacturing approaches are tooling dependent.

Failure to initiate and complete IPF in a timely manner generally results in greatly increased direct labor unit cost for the early units, delayed completion of early units and delays in the start of progress along the expected program learning curve. The increase in early unit cost results from the fact that the investment in special tooling and special test equipment is justified on the basis of unit cost reductions. There may also be unforeseen additional cost for the revision of the manufacturing process documentation developed during PEP since the documentation was developed on the presumption that the IPF would be in place.

Although claims of large unit cost reductions may be made, the average unit cost over the total production quantity will be higher when FSD tasks are incomplete. A well developed production plan will be more economical in terms of total program cost or average unit cost even though it may follow a higher value learning curve. The number of change proposals will also be less for a well planned program.

Guide References: 4-5, 6-20, 11-10

### Integrate Spares Production

As the system is deployed and enters training and operational use, there is a continuing requirement, on many systems, for spare and repair parts. To the extent possible, the manufacture of these parts should be integrated with the basic system production to take advantage of the lower costs associated with larger fabrication lots within the facility. The spares items to be produced can also impact the cost estimate where learning curve analysis is used at lower levels of the system hardware since the spares quantities can increase the number of units built above that shown on the end item schedule. Failure to consider the capacity needs for spares can result in diminished capability to support the fielded system, thus reducing its availability, or a drain on production parts as they are diverted to support of the deployed systems.

A second source for spare parts may be desired to ensure future delivery or for enhanced competition. The production phase is an opportune time to solicit second source bids and identify possible spare parts suppliers. The data package is complete and quantity requirements for quantity buys may be sufficient for a supplier to tool up for the parts.

Guide References: 3-20, 6-21

Maintain Production Surveillance

One of the primary program management tasks during this phase is to establish and maintain a system for accomplishing surveillance over the progress of the contractor performing the manufacturing tasks. Generally, the program manager will want to ensure that information is available to measure contractor effectiveness from time, cost and technical achievement standpoints. The program manager must also choose between a formally structured and contractually specified management control system or a currently existing contractor system. When problems occur during the production phase, the management control system should provide timely information to the program manager in a format that will support decision making and action processes.

Guide References: 6-22, 10-1, 13-16

Implement Product Improvement

The Follow-On Operational Test and Evaluation (FOT&E) and the initial user feedback on the system often identify areas where improvements can be made to the system to allow it to better meet the constantly changing operational environment. The challenges for the program manager involve the decisions on which of these improvements to make, and the method of incorporating them on the production line. To minimize production cost, the number of engineering changes should be kept to a minimum, but operational requirements often militate in favor of change. A program may also involve preplanned product improvement. If this acquisition strategy applies, when and how to incorporate such improvements must be resolved early in the program.

Guide References: 3-24

Provide and Support Government Furnished Property (GFP)

Where a decision has been made to provide use to the contractor, the program manager must ensure that the property, conforming to the technical description, is delivered to the contractor in accordance with the agreed-to schedule. The primary motivations for providing government property to contractors are to reduce cost and increase standardization within the logistics system. The trade-off for these benefits is the acceptance by the government of some of the responsibility for contract performance. When GFP is involved, the contract clause provides that if the GFP is late or defective there may be an adjustment to the contract schedule, or price, or both. It is, therefore, incumbent upon the program office to ensure that an effective management control system is established to; a) validate contractor need dates, b) budget for the GFP, and c) acquire the GFP and deliver it to the contractor on time.

Guide References: 4-5

Accomplish Value Engineering

Value engineering (VE) is an organized effort directed at analyzing the function of a product or system for the purpose of achieving the function at the lowest overall cost. During the production phase, the value engineering effort amounts to a reappraisal of the design from both a functional and cost standpoint. There are two ways to include value engineering in the production phase contract: by a Value Engineering Incentive Clause or by a Value Engineering Program Clause. The VE Incentive Clause provides the contractor with the opportunity to submit Value Engineering Change Proposals (VECPs) and to share in the savings accrued from approved VECPs. The VE program clause requires the contractor to establish a VE program within his facility to identify potential applications of VE and prepare VECPs.

VE has the potential to significantly reduce acquisition and support costs for those elements of the product or system to which it is applied. In addition to including the appropriate contract language, the success of a VE program is critically dependent upon the level of program office support which is provided. This support can be provided in two ways. First, the decision makers in the program office can encourage the identification and submission of VECPs. Second, the personnel evaluating VECPs can approach the task with an open mind.

Guide References: 7-16

Accomplish Second Sourcing/Component Breakout

As noted above, competition has been shown in a number of studies to have a beneficial effect in reducing program cost. The plan for introducing competition during the production phase can involve either the establishment of a second source or the breakout of selected components of the system for direct government (preferably competitive) procurement. Accomplishing government objectives in these two areas requires that the data and data rights are obtained from the developing contractor. These rights should have been obtained during the development phases with data delivery late in FSD or early in the production phase. Since the introduction of new sources will involve contractors who may not have the benefit of the development experience, a careful plan for technology transfer must be established. Many times, successful manufacture of a product or system is dependent upon processing factors not disclosed in the technical data package.

Guide References: 4-6, 4-8

Complete Industrial Preparedness Planning

The Industrial Preparedness Planning (IPP) program focuses on establishing the capability to support increased levels of usage of equipment resulting from combat operations. The primary emphasis during the production phase is the evaluation of the ability of the contractor base to surge production to meet higher levels of consumption. As the production phase is nearing completion, action needs to be taken to determine if any of the subsystems or components of the defense system will be critical to support of wartime operations. If so, the mobilization requirements for the items must be identified, contractor plans for accomplishing the mobilization must be established, and the capability to execute the mobilization must be created or retained from the production phase equipment.

Guide References: 2-13, 3-20

Plan for and Accomplish System Transition

As the system acquisition process is completed with the attainment of the acquisition program objectives, the responsibility for the product or system acquisition functions: procurement, engineering, finance, and logistics is dispersed through the respective Service organizational structure. The effort focused on the program management approach is no longer needed. The program manager must ensure that documentation of the system is complete, and the support requirement is properly defined and structured.

Guide References: 3-18

## POST PRODUCTION SUPPORT AND PROGRAM TRANSITION

The term “transition” is analogous to many terms used throughout the Services to describe the attainment of the acquisition program objectives and the dispersion of product/system acquisition functions — procurement, engineering, production finance, logistics, facilities — in whole or in part throughout the respective Services, organization structures. A sample of such terms include “transition planning,” “program transition,” and “turnover management.”

Program management documents and master schedules must include transition considerations. While the mechanics involved in transition will vary among the Services, the end result is the availability of the system for use by the operating forces in consonance with DOD objectives.

Emphasis in weapon system acquisition has been on early production and delivery and the establishment of support capability to coincide with initial fielding of the system. This has often forced provisioning to be accomplished in a very short time. While some success has been achieved in having spare parts on hand, it has virtually eliminated our ability to establish competitive sources or assure fair and reasonable pricing of these spare parts. If the Services are to support weapon systems as they are delivered into the inventory, and obtain spare parts at fair and reasonable prices, some radical changes in the weapon system acquisition process will be required.

Interface Questions

With considerable resources now invested in the product/system, many interface questions become extremely crucial. Are organizational force and equipment tables, allocation of units, and field support plans compatible with the production planning? Have the production rates been established for support program requirements, support and test equipment, spares support, storage and transportation, and training? Have test and demonstration requirements been established and a methodology developed for incorporating user changes in documentation for release to production? Are plans formulated for updating specifications and drawings to reflect the production design and for obtaining suitable technical documentation packages necessary for considerations such as competitive procurement and component breakout?

As noted above, a host of program transition considerations confront the program manager in the production and deployment phase. While relatively dormant earlier in a program, these considerations suddenly become critical at the very height of the production process. Has a risk analysis identified potential production plan and rate deficiencies? Is the producibility plan adequate for full and follow-on production? Are the various facilities, tooling, industrial capacity and related schedule plans current? Have Foreign Military Sales (FMS) and other Service requirements as well as related production processes, rates and quantities been validated, documented and kept current?

As the focus shifts from the program manager to the internal Service interface, those seeds sown early-on in the product development process will mature and, if done properly, will ensure program integrity to the system user.

Changing Production Capability

The program manager should be aware of changing production capability as the transition from production to spare parts provisioning will severely reduce his opportunities for future spares procurement if production facilities are changed to accommodate a new product line, material needs change or new tooling for special purpose machines is installed. If extended production runs did not provide a spare parts inventory, the cost of parts produced at a later date can be significantly higher than the original procurement. Conditions which drive up spare parts prices include:

a) Smaller order quantity requirements.

b) Orders for earlier configuration units which require special documentation.

c) Parts require special purpose tooling.

d) Unique or scarce material requirements.

e) Lack of production capability due to a number of factors: Out of business, discontinued facilities, lack of available production capacity, etc.

f) Special handling, packaging and shipping requirements.

End Item Production Endangered

DOD Directive 4005-16 establishes policies and assigns responsibilities to assure that timely action is initiated when essential end item production capabilities are endangered by the loss or impending loss of manufacturing sources, by material shortages, or that have been reduced to a single source with inadequate production capabilities. DOD components have a responsibility to coordinate with operational activities within other government agencies on the identification of critical items and possible solutions, when faced with a material shortage or manufacturing phaseout.

Implementing Procedures

In accordance with DOD Directive 4005.16, each DOD component shall develop implementing procedures by the initiation of prompt and timely actions to assure the availability of critical materials and manufacturing capabilities to support current and planned defense requirements. Component responsibility includes:

1. Establishing and maintaining a single organizational focal point to monitor all material shortage and diminishing source situations.

2. Developing plans and simplified coordination mechanisms to deal with existing and potential diminishing manufacturing sources and material shortages, including interaction with government activities.

3. Taking rapid remedial action when faced with a material shortage or manufacturer phaseout.

4. Initiating actions to reduce reliance on sole source manufacturers and suppliers through the development of additional sources or coordination of substitute items with equipment users.

5. Maintaining close contact with industrial/scientific and engineering organizations and industry through a system of follow-ups to discern future trends.

6. Using engineering, standardization and technical organizations to assure that the most current standard or preferred parts are used in systems design and development.

7. Reviewing the efforts of other government departments in the area of material shortages and production phaseouts. Using output from their system where possible and ensuring that a compatible data interchange method is established.

8. Developing compatible management techniques through coordination with other DOD components and ensuring that adequate information and controls for material shortage and diminishing source situations.

9. Ensuring that diminishing manufacturing sources and material shortages are recognized in the DSARC proceedings.

10. Developing a technique where feasible to identify “end item application” for those critical or weapon system essential items affected by shortage/phaseout conditions.

11. Seeking manufacturer’s and supplier’s commitments to provide maximum advance notice prior to phasing out production or supply of material.

12. Advising using Military Departments and other users of date(s) beyond which support will no longer be provided for item(s). The DOD components are responsible for notifying International Logistics (IL) customers.

While the mechanics involved in transition will vary among the Services, the end result is the availability of the system for use by the operating forces in consonance with DOD objectives. Transitioning the system to the operational forces, and developing as well as monitoring and controlling transition milestones become especially important in the production phase of the system acquisition process.

Support for Out-of-Production Systems

Support for out-of-production systems should provide an organized approach and methodology for attaining competition and fair and reasonable prices for spare parts no longer in production.

For out-of-production systems, the weapon system program manager should consider the value to DOD of establishing post production support agreements for those systems. This can ensure that costs for required spares do not reflect source constraint circumstances leading to unreasonable prices. Procedures also need to be established to qualify additional manufacturing sources to provide competition on specific parts. These procedures should be consistent across the procuring agencies and should allow for qualification across general groups of items built using the same manufacturing process.

High Value Spare Parts Breakout Program

For items which represent recurring spare parts requirements and substantial annual buy value, aggressive action to develop alternative sources of supply is required. These sources ensure continuing part availability and competitive sources for these parts. The process of establishing competitive sources for these parts starts early in the production phase and continues as long as they are in the supply system.

During the provisioning process, decisions are made in consonance with the Maintenance Concept, including what spare parts will be specified, and what spare parts new to the inventory must be identified and purchased to meet initial support requirements. After identification of the spare parts required to support the Maintenance Concept, decisions also must be made as to how they will be procured in terms of competitive posture. The intent of the High Value Spare Parts Breakout Program is to identify those high dollar spare parts which offer the greatest potential savings through competitive procurement or “breakout.” High Dollar Value Replenishment Spare Parts can be defined as spare parts included in those items ranked in descending order of annual buy value (computed by multiplying the unit price times the annual buy quantity) which represent at least eighty percent (80%) of all dollars expected to be spent in the 12-month period when measured in descending order from the highest annual buy value item.

Usually, the developing contractor is asked (required by the contract) to provide the contractor technical documentation as a basis for government decision on the method of purchase. Each item is screened by the government and the item is assigned an Acquisition Method Code (AMC) and AMC Suffix Code in accordance with DOD FAR Supplement 6. The AMC will determine how the item will be purchased unless changed by subsequent review. The suffix code explains the basis for assignment of the AMC. During the life of the part or item, regular screening intervals (often three years) are established. At each screening, the item management organization reviews the forecast buy and the item to determine if action could be and should be taken to develop competitive sources for the item.

CAO Involvement

Significant improvements can be attained by greater involvement of the Contract Administration Offices (CAOs) in the spare parts acquisition process. This involvement should include review of prime contractor vendor competition, source identification for direct purchase, limited rights assertions and price reasonableness of prime and subcontracted spare parts. This effort should be implemented through use of support and interface agreement consummated between the CAOs and the involved buying activities. The increased CAO involvement will add to the spare parts acquisition program the knowledge and access that results from the continuing relationship between the CAO and the prime contractor. Specific management attention must be directed to the identification and quantification of price pyramiding on spare parts. Removing situations in which prime contractors and upper tier subcontractors add cost to an item without adding value can make a significant contribution to achieving fair and reasonable prices for spare parts. This can be achieved by breaking these parts out for direct purchase from the actual manufacturer (or possibly for open competition).

Life of Type Buy

When all other alternatives have been exhausted for an item no longer to be produced, life of type buy, a one-time procurement may be necessary. Procurement quantity, according to DOD Directive 4005.16, will be based upon demand and/or engineering estimates of mortality, sufficient to support the applicable equipment until phased out of the system.

Post production support will, by focusing organizational resources on improving the process by which spare parts are acquired, assure a more efficient and responsive logistics support program, as well as normalize the price paid for each part.

## MANUFACTURING CONCERNS RELATED TO CONTRACTING SUPPORT

The model presumes that each phase of the acquisition process will be accomplished through a separate contract action. This will not be true for all programs since the program manager has the flexibility to develop acquisition plans which may combine phases within single contracts or delete specific phases based upon the strategy developed for the individual acquisition program. Irrespective of the particular acquisition strategy, almost every program will have at least one contract action associated with it and the vast majority of programs will have a number of contract actions. The significance of these actions lies in the fact that the implementation of the manufacturing management goals of the program is accomplished primarily by the contractor, and program success depends upon establishing clear contract provisions for each contract let during the system acquisition. This section provides a brief discussion of the typical activities which would be required from the manufacturing management group in support of the contracting effort.

Figure 3-3 provides a graphic representation of some of the major events to be supported during a contracting action. The approval of a program through the Acquisition Decision Memorandum (ADM) or other similar documentation, combined with availability of budget funds, provides the basis for a solicitation document, usually a Request for Proposal (RFP) to industry. The manufacturing management function provides to the contracting officer the detailed requirements for the manufacturing tasks to be accomplished during the period of contract performance. This could include statement of work language, data items or contract special provisions required to achieve the manufacturing management objective defined for that period of performance. The development of these requirements should reflect the types of activities described in the model for the particular acquisition phase(s) covered by the contract, as well as other requirements which reflect areas unique to the specific program.

For each of the requirements included in the RFP, evaluation criteria need to be established. These criteria should focus on those elements of the proposal which could affect system effectiveness, the contractor's ability to produce the system or the government's ability to support it. The developed criteria are needed to describe the minimum performance or compliance acceptable to enable a contractor to meet the requirements of the RFP. These criteria are then used as a basis for the evaluation of the individual contractor proposals. In performing the proposal evaluation, the evaluator needs to know the requirement as stated in the solicitation, and what is considered to be the minimum acceptable response. For each area, generally, the evaluator must provide an evaluation of the contractor's proposal, in particular whether it meets or exceeds the minimum requirement; a narrative discussion of the evaluation; and an assessment of the risks attendant to the contractor's proposed approach.

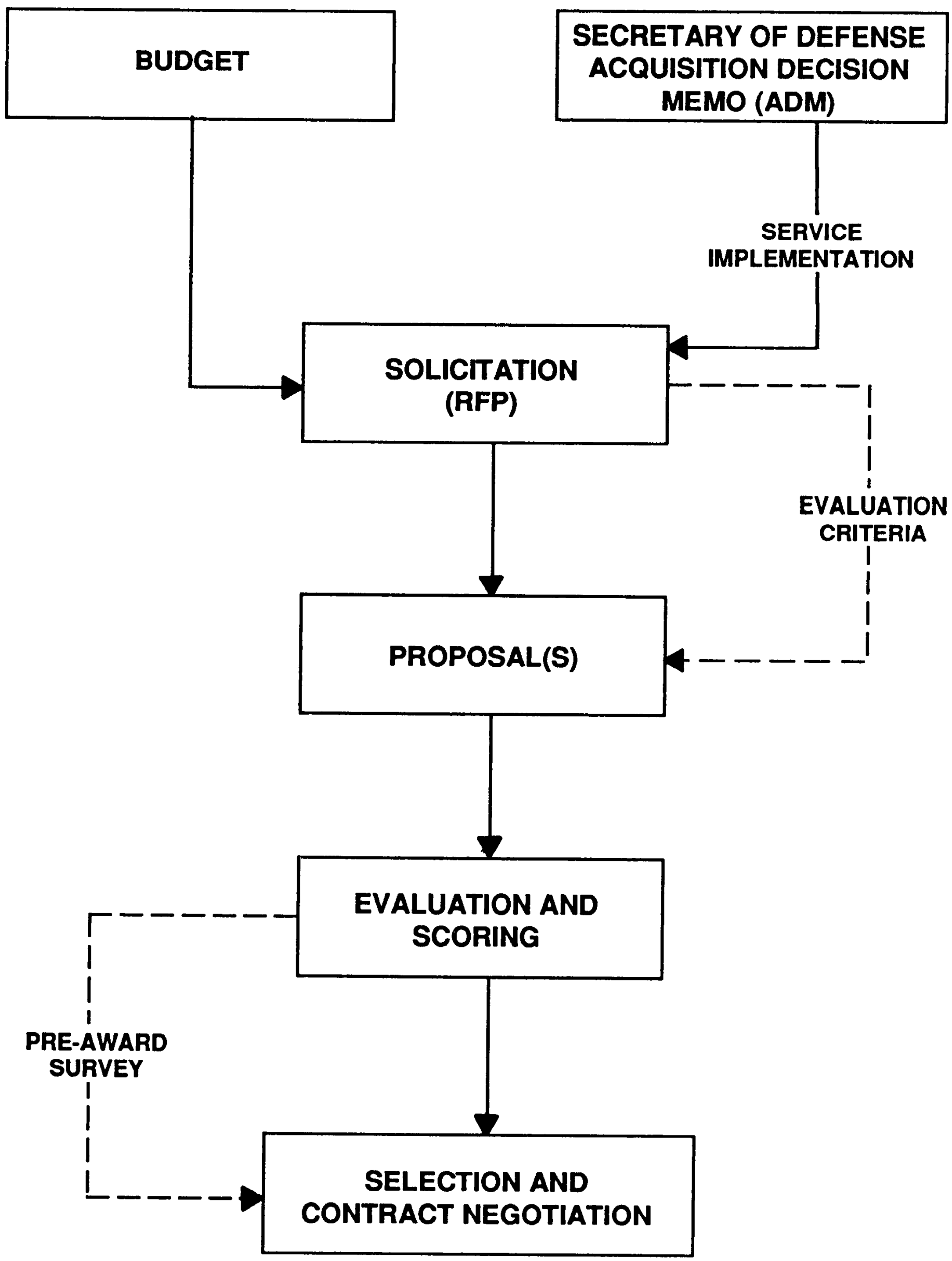


**Figure 3-3 Contracting Support**

The individual evaluations are then combined according to the individual scoring and weighting system for the particular contract action to develop relative measures of the proposals received. It is important to note that proposals are measured against the standard — not against each other. The technical evaluations are combined with the evaluation of the cost proposals to determine that proposal which is most advantageous to the government. As an adjunct to the proposal evaluation and analysis effort, a preaward survey of those offerors being considered for award is normally accomplished. This preaward survey is accomplished by the Contract Administration Office (CAO) which has cognizance over the individual offerors' facilities based upon request by the acquisition office (and often with personnel augmentation from the program office). The purpose of the preaward survey is to determine that the offerors have the physical, financial and managerial capability to accomplish the effort described in the proposal.

The support to the contracting process is directed toward ensuring that all required manufacturing management requirements are: a) included in the solicitation, b) appropriately addressed in the proposal, c) capable of being accomplished by the proposing contractor, and d) included in the contract as awarded. The specific support activity tends often to be more extensive and intense than the discussion above may imply, especially when there are a relatively large number of offerors for a complex system. It is essential that care be exercised throughout the process to ensure that the resulting contract includes those requirements necessary to establish a firm basis for successful manufacture of the ultimate system design.

Review of an individual contractor's proposal, especially with an unsuccessful contractor, can be expected following announcement of award. In these reviews, the information provided should be factual and specific as to the proposal content and program requirements or standards. Although government evaluation factors should be available for review, scores for competing proposals are not to be disclosed as they serve no useful purpose in helping the contractor to identify critical program needs and possible proposal inadequacies.

## PREPLANNED PRODUCT IMPROVEMENT

Preplanned Product Improvement (P3I) strategy which programs resources to accomplish an orderly and cost-effective phased growth of a system's capability, utility and operational readiness. P3I is directed toward the objectives of:

Shortening the acquisition and deployment time for a new system or an incremental capability;

Reducing overall acquisition and operational support costs, extending useful life of equipment, reducing technical, cost and schedule risk;

Accomplishing orderly growth from initial to mature system reliability; and

Reducing logistics and support problems entailed with new material introductions.

### New System Application

P3I is normally applied to a system early in the program _ when it can be a factor in concept selection. P3I is subsequently carried forward in a program by including flexibility in the basic system design to accommodate future evolutionary improvements.

The P3I approach is a useful acquisition concept for new programs under the following circumstances:

There is a long term military requirement to be satisfied,

The threat or need is projected to change as a function of time requiring a change in the response,

Required technical performance or system capability is expected to increase with time, There is a need to field the system in the near term with less than its full capability, and

The sponsoring service is willing to pay higher initial costs to obtain growth potential for future exploitation.

DOD policy being promulgated as a result of the DOD Acquisition Improvement Program (AIP) initiated in 1981 requires the program manager to include P3I as an element of the program acquisition strategy, and to pursue P3I when it is clearly established that its application will reduce risk, acquisition time, and/or overall cost. P3I will not be used to artificially extend the development effort or correct deficiencies encountered in attaining initially specified system performance.

As the design of a new system evolves under a P3I approach, the basic design of the system will anticipate any preplanned product improvements which are identified in the military requirement documents and subsequently contained in the acquisition strategy and confirmed at milestone decisions. Provisions will include structure, space, weight, moment, power, air conditioning, and other accommodations to facilitate production incorporation and retrofit and minimize operational disruptions.

P3I is approached as a design change mechanism for incrementally phased introduction of additional system capabilities at specifically defined points. Each evolutionary materiel change should meet a corresponding aspect of the threat or exploit a technological advantage.

As stated above, P3I is not used to correct deficiencies encountered in the basic development. In particular, P3I is not a test and fix technique to achieve the reliability, availability, and maintainability (RAM) specified for initial operation; however, P3I is used to achieve a planned growth in the RAM level. Resources to accomplish P3I will be made visible during the PPBS cycle and placed in the Five-Year Defense Plan, (FYDP) Program Objectives Memorandum/Budget Estimate Submission (POM/BES) and Extended Planning Annex (EPA). Once P3I becomes a part of the acquisition strategy, failure to fund it will be considered a major change in program.

P3I is to be used where there are legitimate technical and schedule risk impediments to proceeding with a full capability system, but is not to be used as a ruse to initiate an underfunded and unaffordable program. Such programs are destined to become deficient in performance or to suffer early cancellation.

Product Improvement

For on going systems, i.e., those already in FSD or beyond, product improvements should be considered for incorporation only when production incorporation is not more costly than a new design, retrofit costs are reasonable, and equipment downtime is not excessive. Product improvements, rather than new product designs, should be considered under the following circumstances:

- There is change in the threat requiring increased capability or utility which is technically feasible to obtain,
- There is technological breakthrough in advanced development which will present an opportunity for significant advancement in system military worth,
- When improvement in design will provide a cost-effective means for meeting otherwise unattainable readiness requirements,
- When the system is modular or adaptive to accept upgrading,
- When there is sufficient capacity for growth in the design in the form of structural, space, weight, and power provisions so that needed engineering changes can be made without prohibitive modification costs in production or retrofit, and
- The system service life is compatible with the changes entailed.

When a product improvement is made to a weapon system, it should represent a cost-effective approach to achieving the new level of operational capability required.